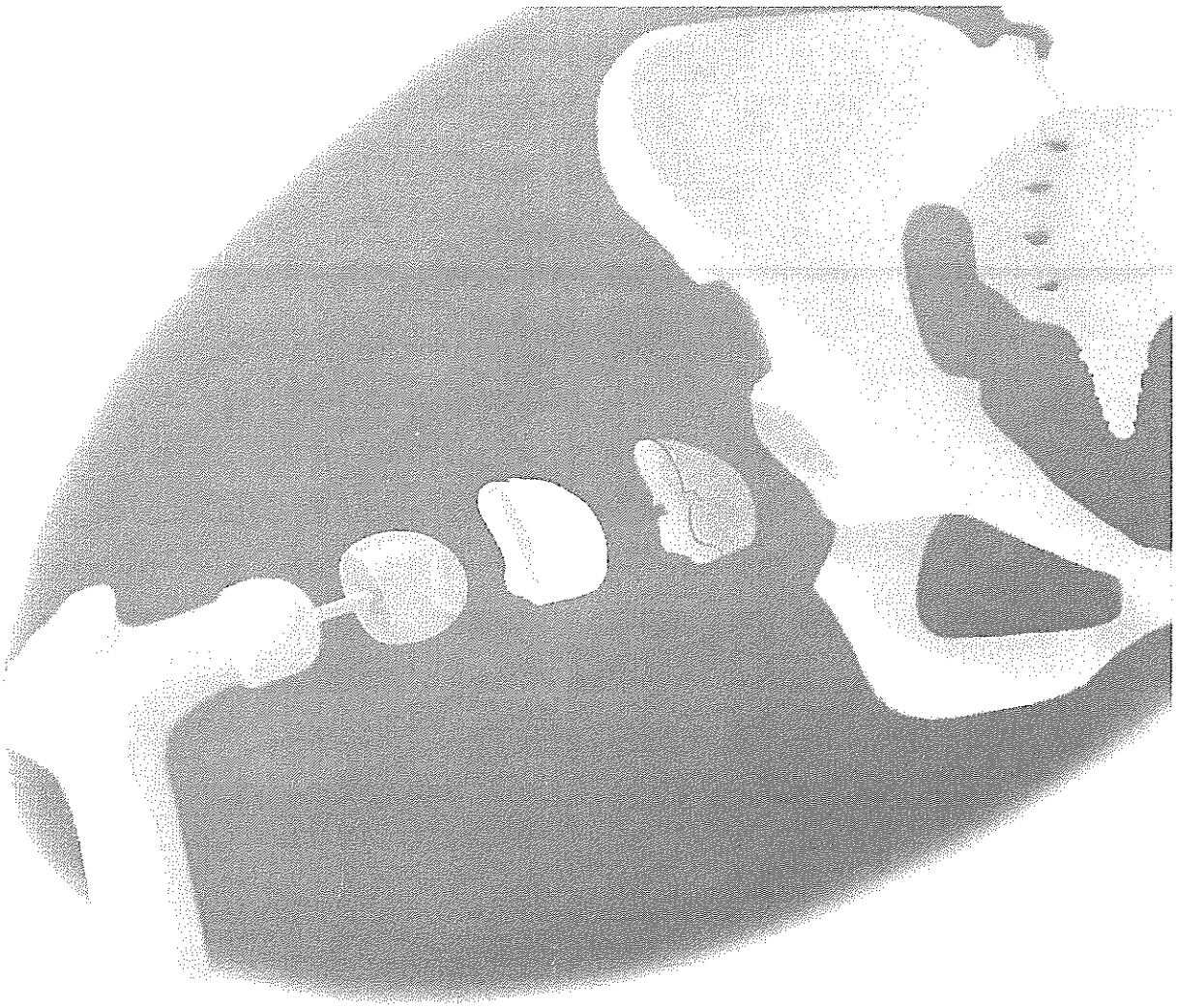
CONSERVATIVE HIP ARTHROPLASTY (RESURFACING)

Surgical Technique



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Surgical Concepts

Introduction

Effective resurfacing total hip arthroplasty depends on several significant surgical concepts, namely: the acetabulum should not be over-reamed; the femoral head should be downsized to the natural femoral head size and oriented in valgus; and the procedure should be technically reproducible for a very highly skilled hip surgeon. Hip resurfacing has never been popular with surgeons because it is much more difficult to access the acetabulum with femoral head in the way. Resurfacing procedures require a higher level or surgical expertise compared to total hip replacement. Aside from the technical aspects of the procedure, the mechanical bearings used should minimize wear and torque to provide lasting results that improve upon prior failures.

With these concepts in mind, the Conservative (Resurfacing) Hip Arthroplasty offers both simplicity and reproducibility in the surgical procedure as well as advanced bearing design and materials to minimize problems of loosening or osteolysis.

The hemispherical socket allows for precise positioning of the cup at the acetabular floor with the ability to adjust minor valgus or version angles by simple impaction of the acetabular cup rim. Elimination of fixation fins, pins, or cylindrical fixation geometries adds to the ease of insertion of this hemispherical cup.

A complete capsular release is necessary to dislocate the femoral head superiority and anteriorly to expose the acetabulum. The gluteus maximus tendon may be released if necessary along with the short, external rotators to allow mobilization of the femoral head into this position.

Acetabular Preparation

Acetabular preparation requires the use of sequential spherical Cheese-grater type reamers to deepen the acetabulum to the floor (outer table of the tear drop), while retaining the subchondral plate in the superior, weight bearing dome. Care is taken to retain the anterior and posterior walls of the acetabulum and use their anatomical position for the proper anteversion, while orienting the cup in the horizontal plane. An interference fit of 2 mm in hard bone, such as osteoarthritis, and 3 mm in soft bone, such as in rheumatoid arthritis, allows the use of these spherical components without screws.

Femoral Head Preparation

Femoral head preparation involves the use of the conical plane of the calcar to orient the femoral head shaper into a valgus position, parallel to the medial border of the calcar, and centered on the femoral neck. Drilling of an osteonecrotic or hypoplastic, femoral head, parallel to the central pilot hole of the shaper, stimulates revascularization. Supplemental, cancellous bone augmentation can be used to fill in apical head defects prior to femoral implant impaction. A short, tapered, central femoral stem is used to align the femoral component and protect the femoral neck from fracture during the postoperative period.

The precise, mechanical fit of these components permits immediate protected weight bearing.

System Concepts & Description

Basic Implant Concepts

A resurfacing total hip consists of three matching components. The size of the components used is governed by both the Acetabular Component size which is determined by the best acetabular fit and the femoral size which is limited by the geometry of the femoral head and neck. There are limits in the bone preparation. Patients must accept that some additional length will be gained as the lost cartilage is restored. It is not possible shorten or lengthen a resurfaced hip very much because the implants must rest on healthy bone. The best femoral and acetabular fit are selected to work together. This avoids over-reaming of the acetabulum, common in earlier designs.

A major mechanical difference between the resurfacing hip approach is that the larger head size substantially increases torque compared to a conventional hip replacement. This is helpful in resisting dislocation and reducing the pressure per square inch but it can increase volumetric wear. Recent studies of titanium nitride (TiN) ceramic coated titanium on polyethylene, however, indicate that the articular friction of a surface replacement head can be reduced below that for Co-Cr alloy heads. Furthermore, wear in a TiN-polyethylene system is very limited. Thus, all metallic components of the system are made of ceramic coated titanium alloy. (TiN) ceramic coated titanium resurfacing cups now make hip resurfacing a viable option for the young, active, patient.

The fixation surfaces of the components are covered with plasma spray coating. The short tapered femoral stem is uncoated to avoid stress shielding of the bone.

Acetabular Components

The Acetabular Component is a 2 mm thick (excluding the porous coating) spherical metal fixation cup. The spherical fixation surface; provides positioning flexibility, ease of acetabular preparation, and minimal loss of acetabular bone. Further, use of a spherical fixation surface minimizes the generation of tensile and shear stresses at the bone-prosthesis interface under varying loading conditions due to the fact that a part of the spherical surface is always perpendicular to the load vector.

The configuration and positioning of the Acetabular Component approximates the coverage provided by the acetabular cartilage it replaces. The Acetabular Cup is positioned to account for necessary inclination and combined anteversion (rotation) of the hip. Thus, normal head coverage, joint stability, and joint kinematics are provided and impingement between the femur and the cup is limited to what is anatomically required of each individual hip. The anatomical placement and configuration produces centralization of the cup on the line of action of the peak load vector since the acetabular cartilage is similarly centralized. This centralization provides the most uniform and the best approximation to normal stress distribution in the acetabulum. Anatomical placement produces an orientation of the components specific to the needs and function of the individual anatomy. It is important to keep in mind that each hip is different.

System Concepts 8: Description (cont'd)

Bearing Insert

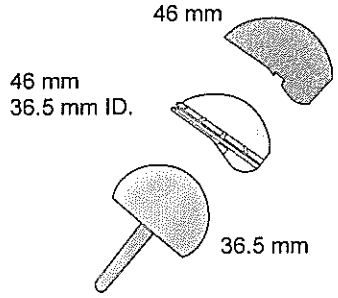
Studies of ceramic coated femoral heads indicate that highly cross linked polyethylene bearings 3 mm thick are satisfactory. A thickness of 4mm was conservatively chosen for the Bearing Insert. The total acetabular cup thickness is therefore about 7mm including 1 mm of coating on the cup fixation surface.

The highly cross-linked polyethylene Bearing Insert is contained fully within the border of the metal Acetabular Cup. This avoids potential deformation of unsupported plastic and avoids levering forces with tend to separate the plastic insert from the metal cup.

Resurfacing Femoral Component

The thickness of the normal articular cartilage of both the acetabulum and the femoral head is about 5 mm. If the size of the Femoral Cup is made identical to the size of the natural femoral head without its covering Since the acetabular cup is 7 mm thick, if one removes 1 *mm* of acetabular bone during reaming then one would have about 1 *mm* or 2 mm of diametral interference between the acetabulum and the Acetabular Cup. This is near the recommended fit. Thus, the Femoral Component is sized to match the diameter of the bone of the natural head and not the diameter over the articular cartilage as has been recommended in other surface replacement procedures. This smaller diameter produces less articulating torque than Metal on Metal sized resurfacing head.

A short straight alignment stem is used to guide the Femoral Cup during its impaction and prevent potential cocking of the cup. This stem also provides resistance against possible neck fracture due to shearing forces in the neck resulting from weak abductors.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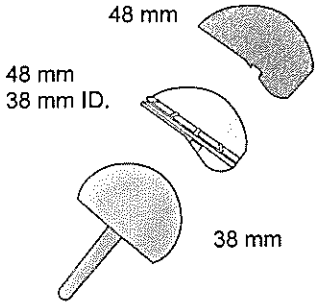
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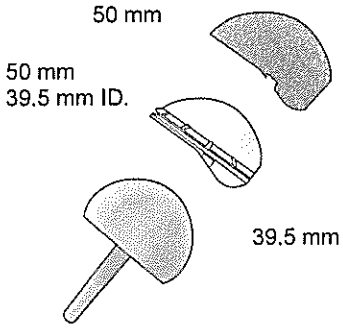
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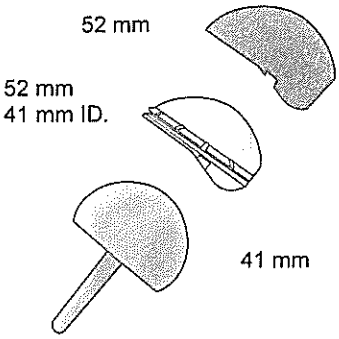
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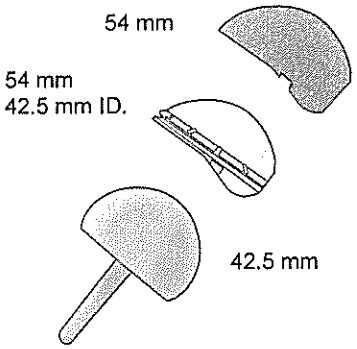
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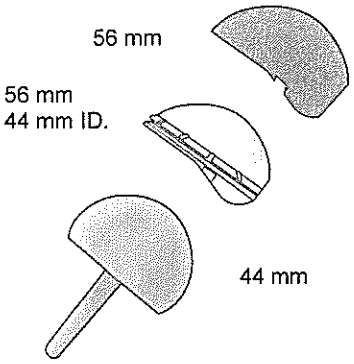
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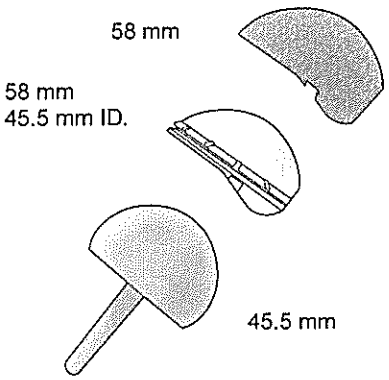
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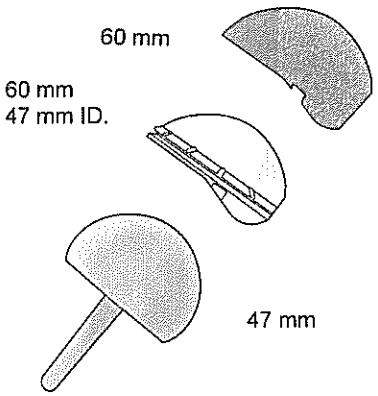
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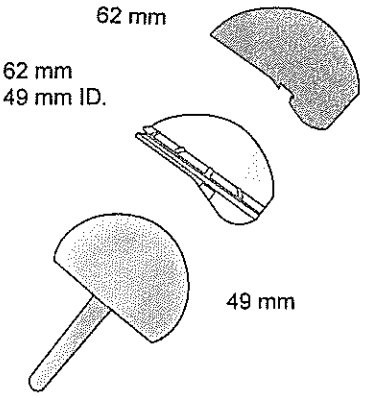
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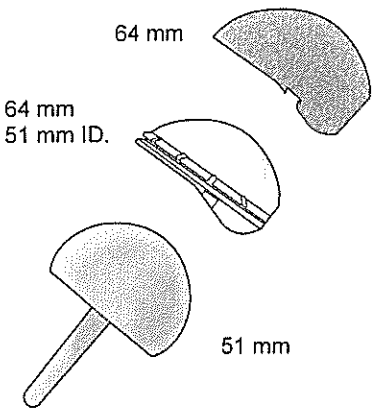
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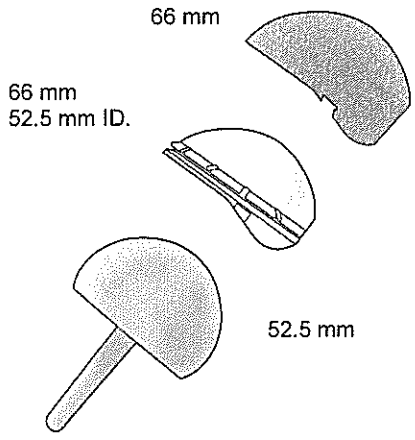
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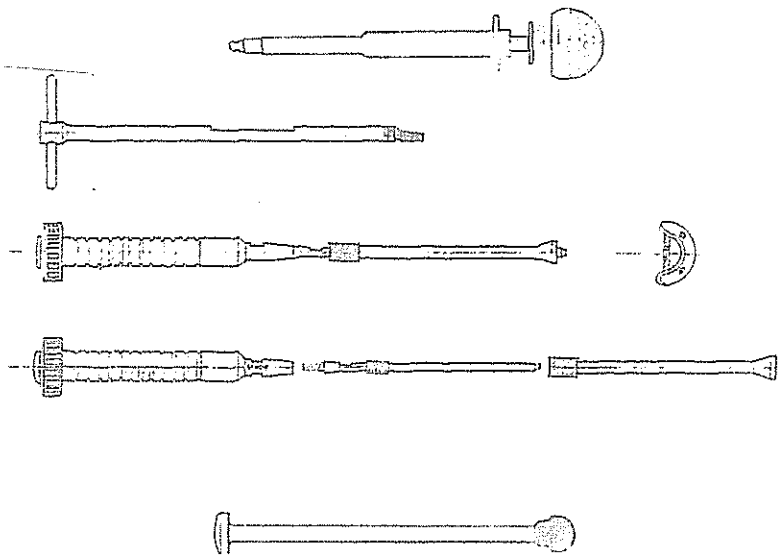
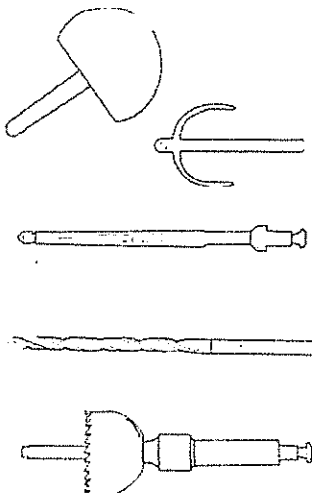
Selected Instruments





Hip Instrumentation Employed

Acetabular Instruments

. Acetabular Reamer Head and Handle

Acetabular Bearing

Acetabular Cup Ball Impactor

Femoral Instruments

'. Femoral Component Impactor

Femoral Head Drill Guide and Size Adapter

Femoral Head Trial (if needed)

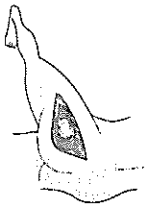
. Femoral Component Template

. Femoral Head Tapered Reamer

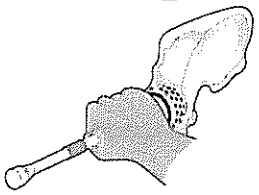
. Femoral Head Drill

. Femoral Head Shaper

Summary of Procedure



1. Exposure



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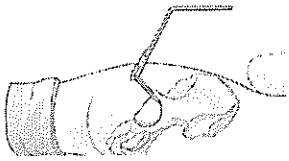

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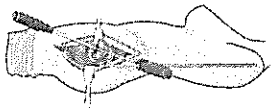

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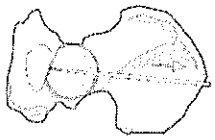

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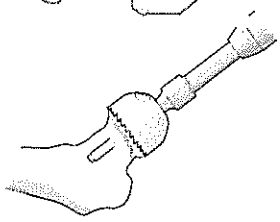
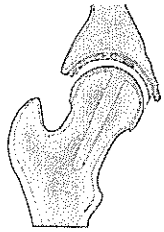


6. Femoral Head Preparation

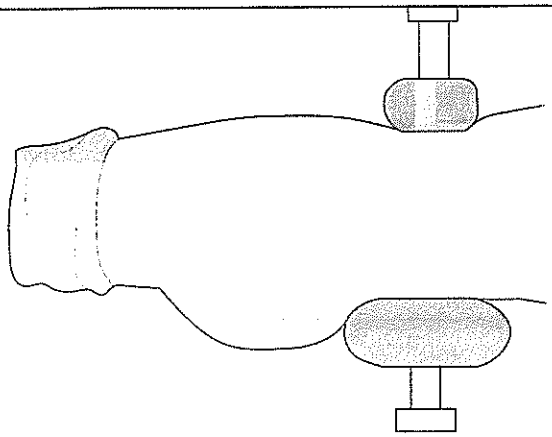
7. Femoral Head Implantation



8. Final Reduction & Evaluation

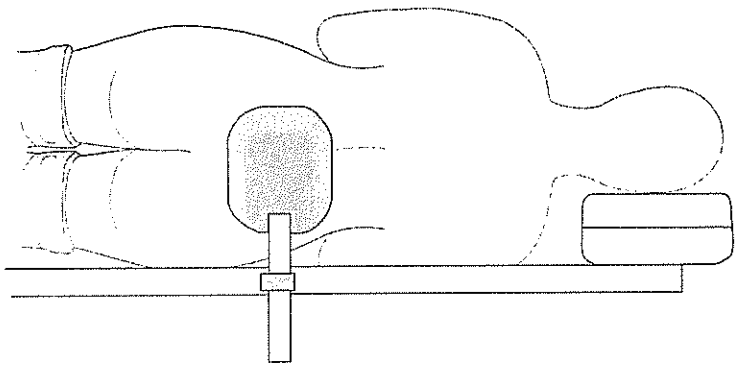
9. Closure & Postoperative Care

1. Exposure



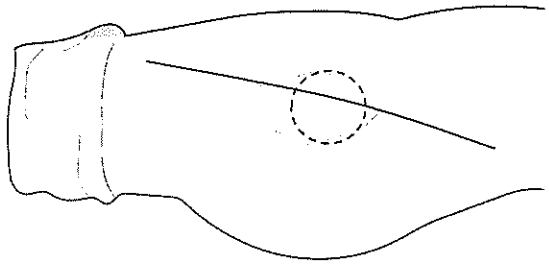
Positioning the Patient

Place the patient in a lateral decubitus position with the affected hip upward. Stabilize the pelvis and body to maintain a neutral position. avoiding any rotation.



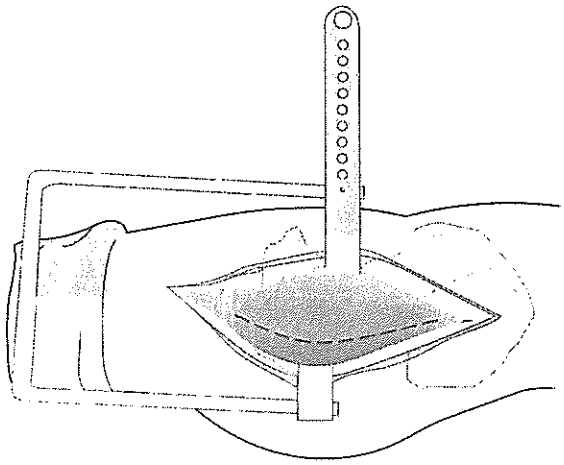
Skin Incision

Make a straight lateral incision centered on the greater trochanter and angled 20°posteriorly, such that the anterior limb of the incision ends at the level of the anterior femoral shaft (approximately 20 cm).



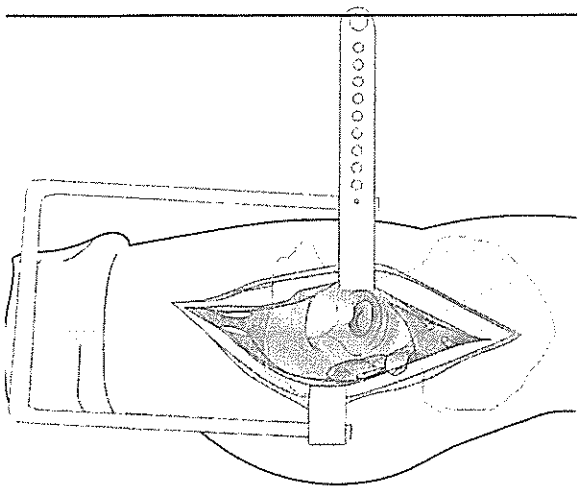
Deep Incision

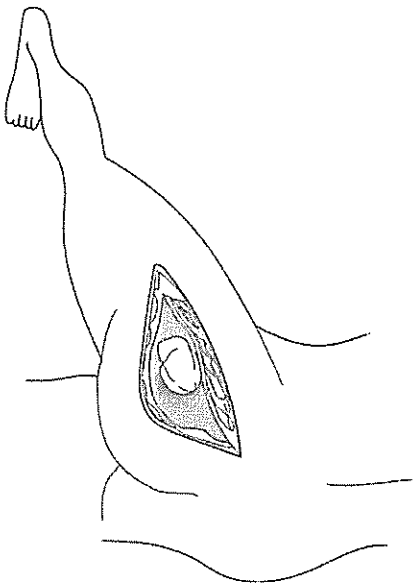
Incise the tensor fascia lata and gluteus maximus fascia in line with the angled skin incision.Bluntly separate the muscle fibers of the gluteus maximus muscle belly for the length of the fascial incision, exposing the trochanteric bursa, the gluteus medius and the insertion of the gluteus maximus tendon.

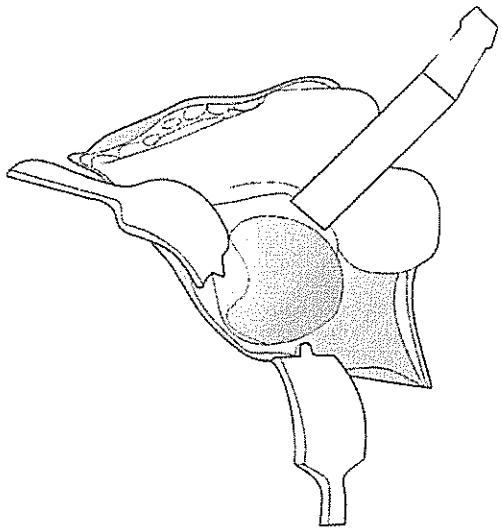


Place a Charnley retractor under the fascia anteriorly and posteriorly at the level of the greater trochanter to facilitate exposure of the Pyriformis, short external rotators and the gluteus maximus insertion.

Exposure (cont'd)







Hip Joint Exposure - Posterior Approach

Internally rotate the hip to place tension on the short external hip rotators, piriformis and gluteus maximus tendon insertion. Using an electrocautery knife, detach as necessary the gluteus maximus tendon 1 cm from its insertion and incise the short external rotators and piriformis tendon subperiosteally from their attachment on the posterior margin of the greater trochanter. Elevate these muscular attachments from the posterior hip capsule, then proceed to carefully incise the entire capsule circumferentially near the acetabular attachment.

Dislocate the femoral head posteriorly to facilitate exposure of the remaining anterior and superior capsular attachments. If necessary, use an anterolateral exposure to incise the entire anterior capsule.

Evaluate the femoral head and neck to determine if bone quality is sufficient to support a resurfacing femoral component. If not use graft, cement or alternative measures.

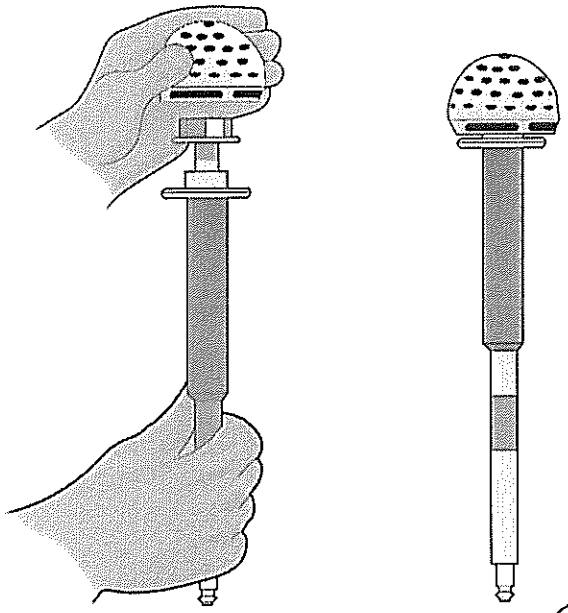
We counsel patients prior to the surgery on the quality of their bone.

Note: Consider preparing the femur first to the size of the actual femoral head. Place the trial femoral resurfacing component as necessary on the femoral head for protection, then dislocate the femoral head with trial component superiorly and anteriorly to give good acetabular visualization. After acetabular preparation and placement of the acetabular component, the fine femoral component preparation can be completed, usually by ---- several millimeters to match the final acetabular size (see p. 13 - 14).

Acetabular Exposure

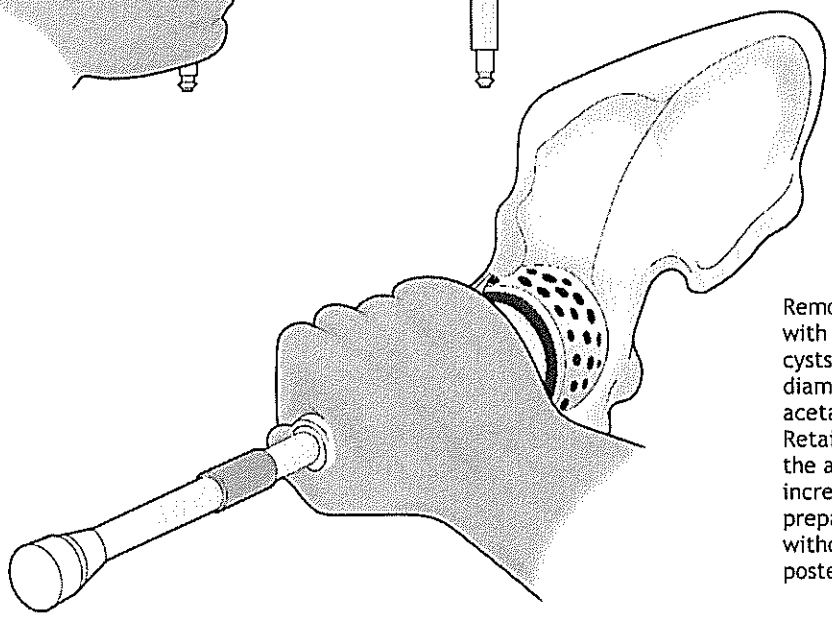
Orient the dislocated femoral head superiorly and anteriorly. Place a long, curved Anterior Narrow Hohlmann type retractor anterior to the acetabulum to hold the femoral head and neck in this dislocated position, exposing the anterior and superior margin of the acetabulum. Place pin (T-handle) retractors posteriorly and inferiorly to completely expose the rim of the acetabulum and protect the sciatic nerve.

2. Acetabular Preparation

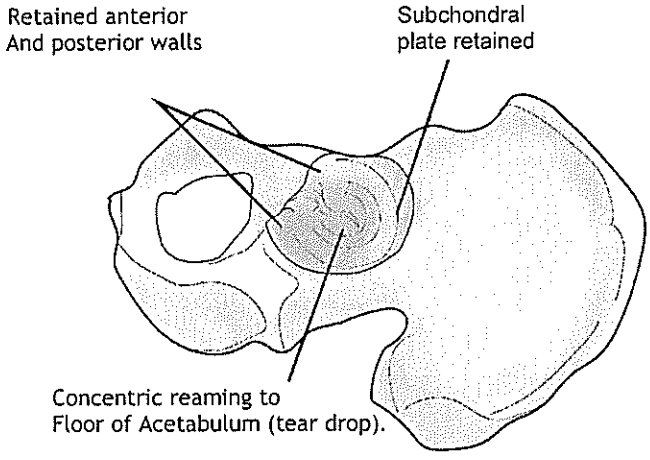


Acetabular Preparation

Assemble the correct size **acetabular reamer head** and handle. Retraction of the Reamer Sleeve allows removal of the **reamer head.** Engagement of the Reamer Sleeve prevents the reamer head from disconnecting from the **handle.**

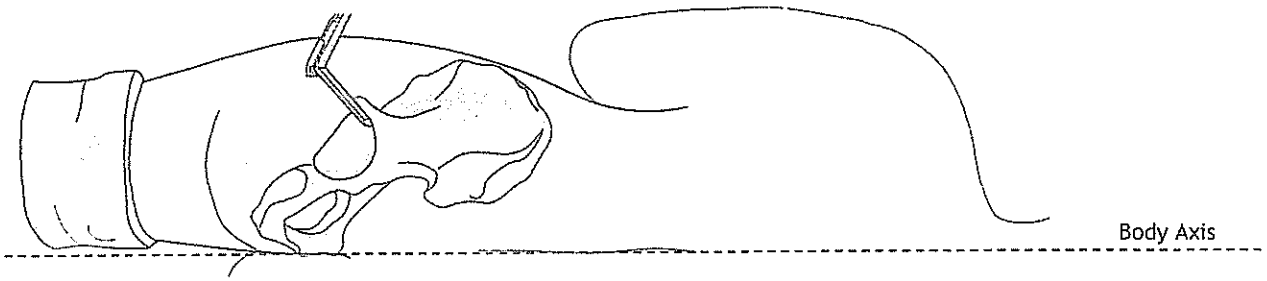


Remove the soft tissue contents of the acetabulum with curettes. Assess the bony walls for defects and cysts. Remove all loose tissue. Use the smallest diameter reamer that fits snugly to deepen the acetabulum to the floor of the acetabular fossa. Retain the subchondral plate in the superior region of the acetabular dome. Widen the acetabulum with increasing diameter reamers until a concentric preparation meets the floor of the acetabular fossa without removing the outer table of the anterior or posterior walls.



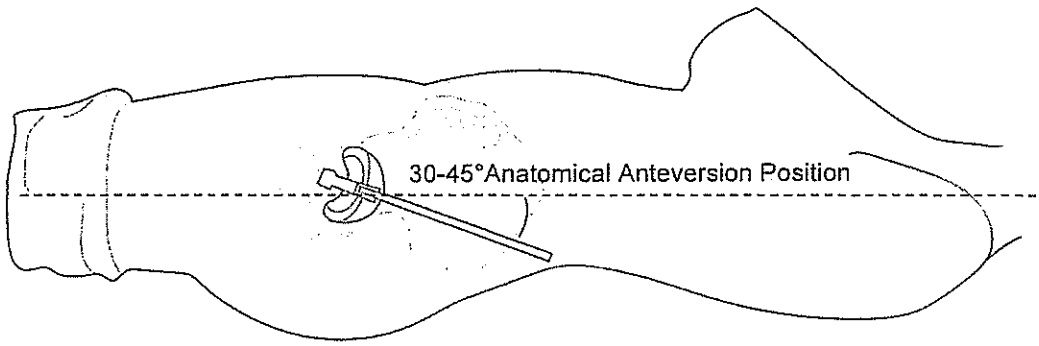
Note: Continuous downward pressure on the reamer sleeve will prevent removal of the subchondral plate in the superior acetabular dome during the reaming process.

3. Acetabular Trial Fit and Component Selection



Acetabular Component Trial Fit

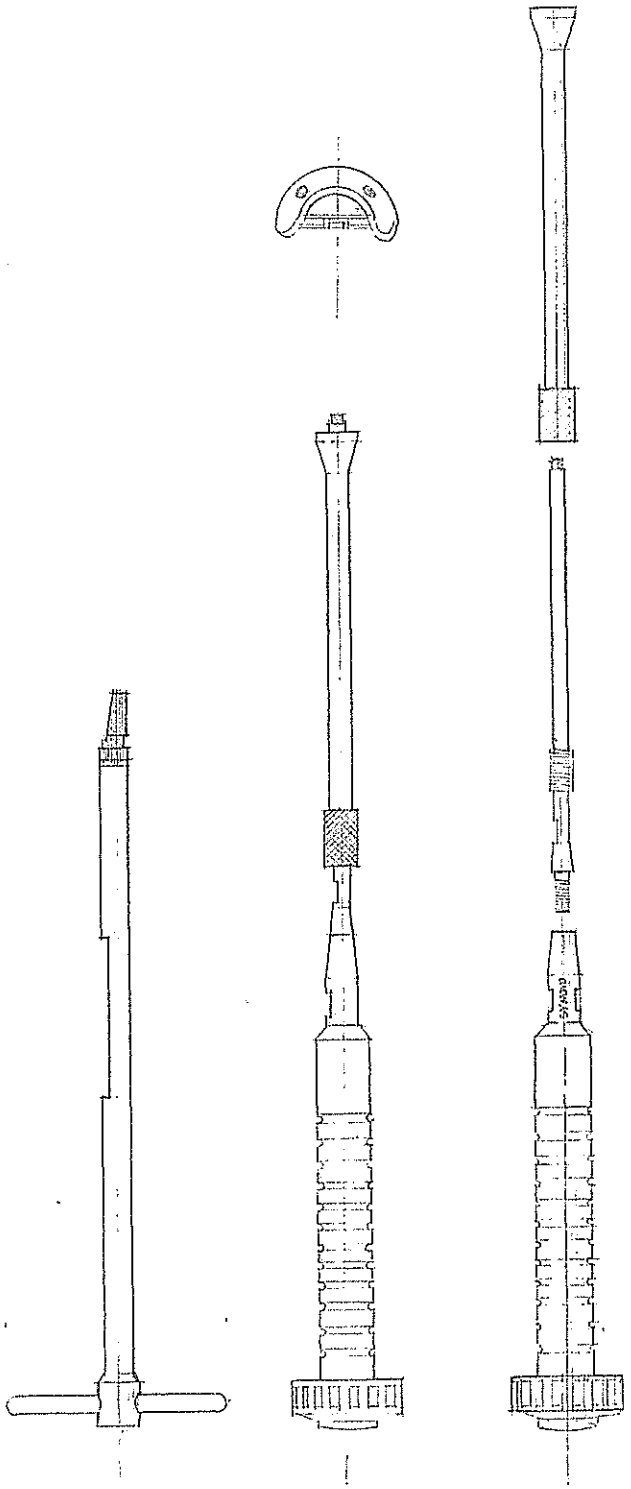
Assemble the acetabular sizing trial and its handle. The trial represents the dimension of the implant with porous coating, and are identical to the implant of that size. Place the trial into the prepared acetabulum and check for bony fit, coverage, and orientation. The fit should be tight with no side play or tendency to rotate against resistance. The Trial should be positioned an atomically in anteversion with the handle parallel to the body axis (usually 30°to 45°).



Acetabular Component Selection

Press-fit application requires an acetabular cup size of 2 mm larger than the reamed cavity in hard bone such as osteoarthritis and 3 mm larger than the reamed cavity in soft or osteoporotic bone such as in rheumatoid arthritis. Thus, the final acetabular component size will be either 2 or 3 mm larger than the reamed cavity depending upon the bone quality.

4. Acetabular Component Implantation



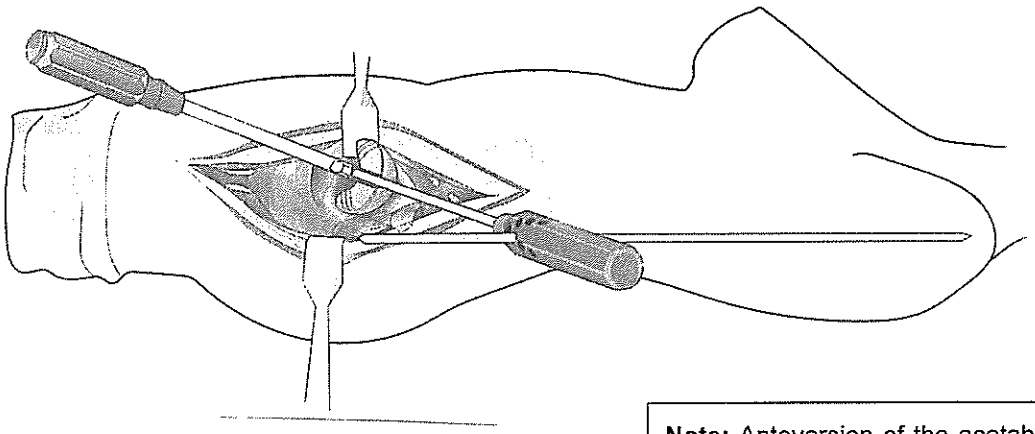
Acetabular Component Placement

Assemble the properly sized Acetabular Component onto the acetabular cup positioner. Thread the acetabular cup holder/impactor into the central hole in the acetabular component.

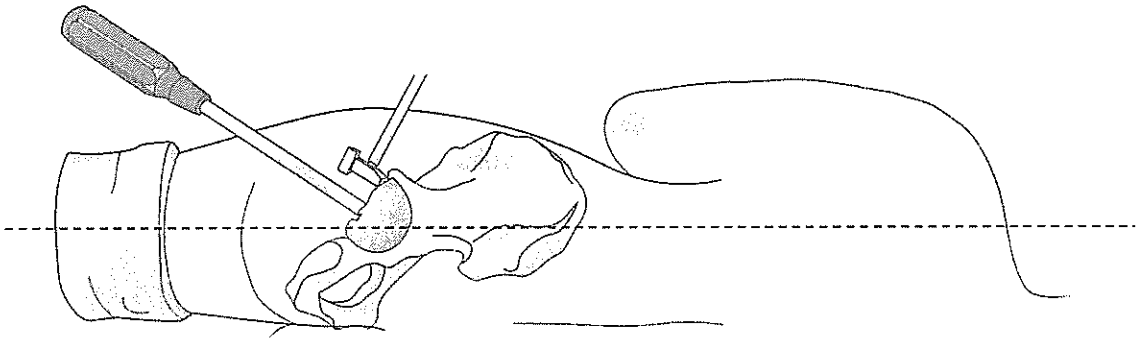
Impact the polyethylene into the shell using the appropriate specific sized polyethylene impactor. Use the black tip polyethylene impactor for final seating

Acetabular Component Placement

Insert the Acetabular Component into the same version position as determined during trial reduction. Bring the alignment rod of the **acetabular cup positioner** in line with the body axis to allow a 30° face angle from the horizontal axis (line drawn between the ASIS).



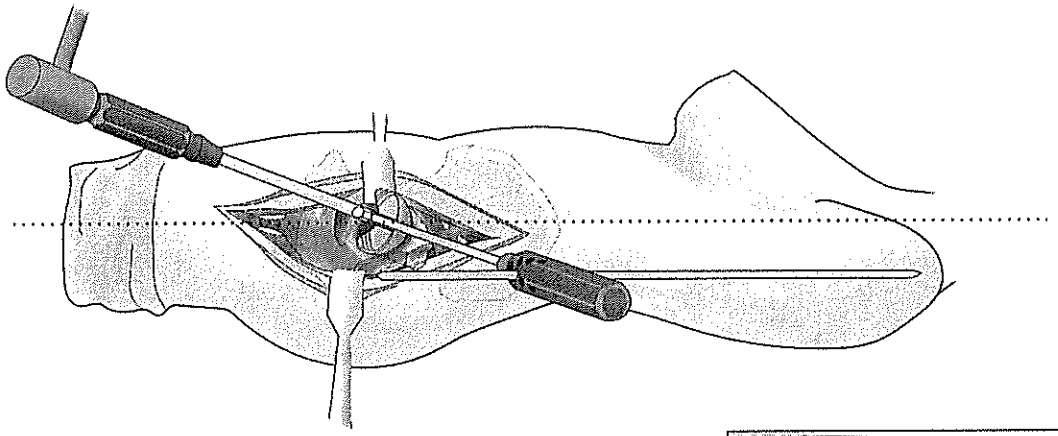
Note: Anteversion of the acetabular cup should be referenced from and recessed inside the bony acetabular borders, except superiorly and posteriorly where the cup may extend slightly, improving dislocation resistance at 90° of flexion and 45° of internal rotation. From the posterior approach the anteversion angle may appear to be 30° to 45° because of pelvic tilt.



Acetabular Component Implantation (cont'd)

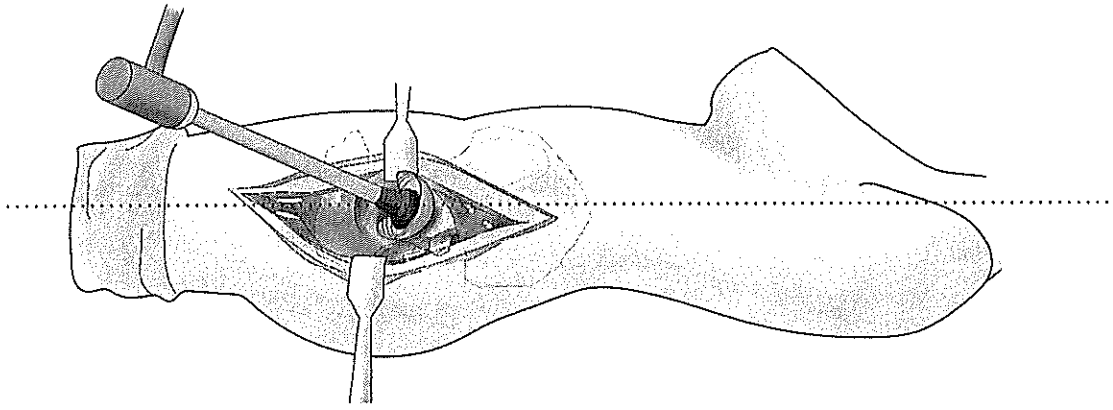
Acetabular Component Impaction

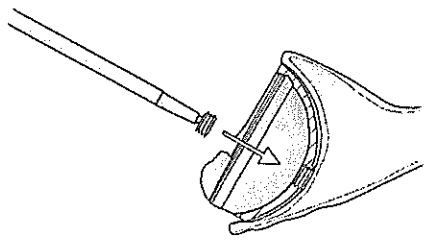
Impact the cup into the prepared acetabulum, using the acetabular cup holder/ impactor. Once this cup is fully seated, remove the acetabular cup positioner and unscrew the acetabular cup holder/ impactor.



Check the depth of seating of the cup with a clamp through the central hole. If incompletely seated, use the spherical Acetabular Cup Impactor to fully seat the metallic cup.

Note: Fine tuning of acetabular cup placement or version angles can be performed by impacting the rim of the cup with a bone tamp (Square Moe Impactor is best). Take care not to damage the keyways.

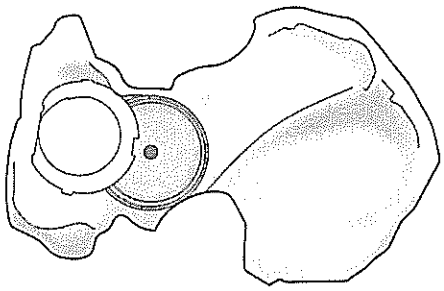




Optional:

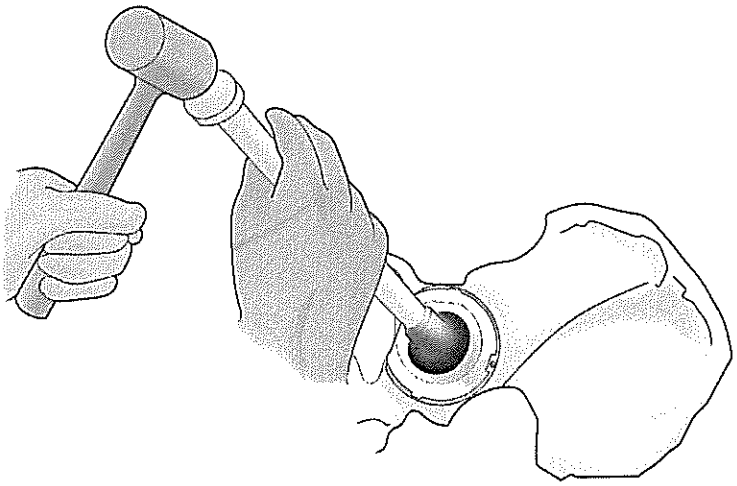
Once the proper position has been achieved, fill the central hole of the cup with the acetabular cup plug.

5. Bearing Insertion

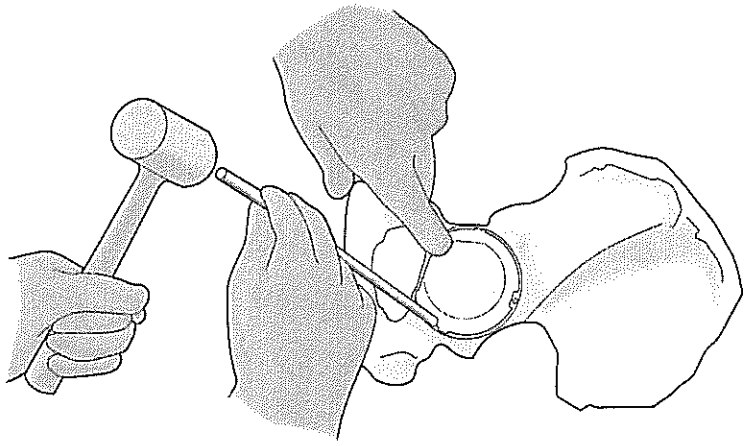


Inserting the Acetabular Bearing

Rotate the highly cross-linked UHMWPe Acetabular Bearing to engage the superior surface keyway in the Acetabular Component. Apply firm digital pressure and engage the two lateral bearing tabs in the slots in the metal cup.

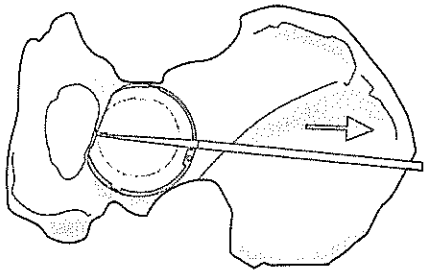


Impact the bearing into the cup using the **acetabular cup impactor.**



To improve seating, impact the two lateral bearing tabs into the mating slots on the metallic cup using the **bearing impactor** Rod. The **bearing impactor rod** is used to firmly seat the lateral bearing tabs until the rim of the polyethylene lies flush with the rim of the metal cup.

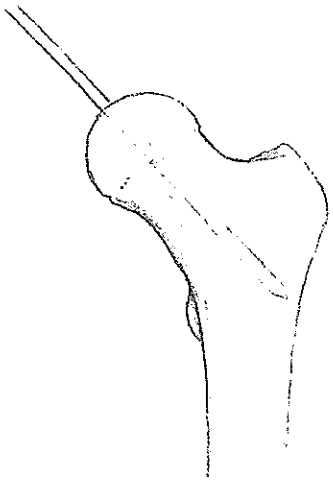
Note: A second blunt rod or an assistant's digital pressure may be used to stabilize one side of the polyethylene cup, while the opposite lateral bearing tab is seated into the slot.

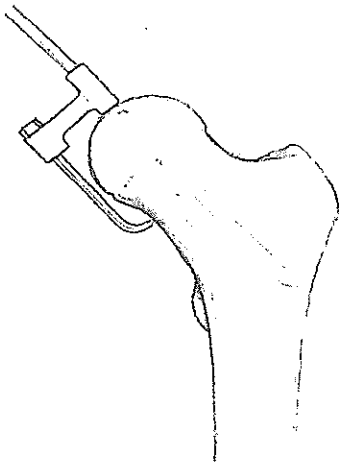


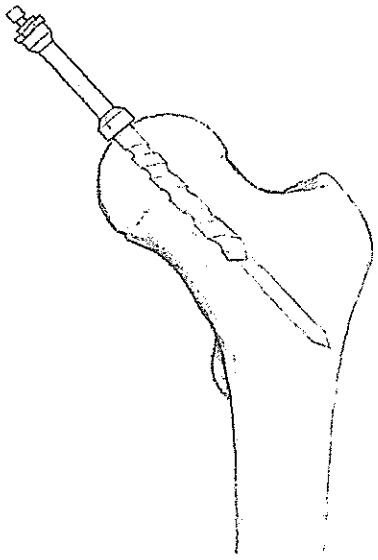
Checking the Acetabular Bearing

Hook the inferior surface of the Acetabular Bearing with the **bearing hook** and pull upward to check the stability of the seated bearing. If the bearing comes free, repeat the seating process or use a new bearing if any instability exists.

6. Femoral Head Pin Guide



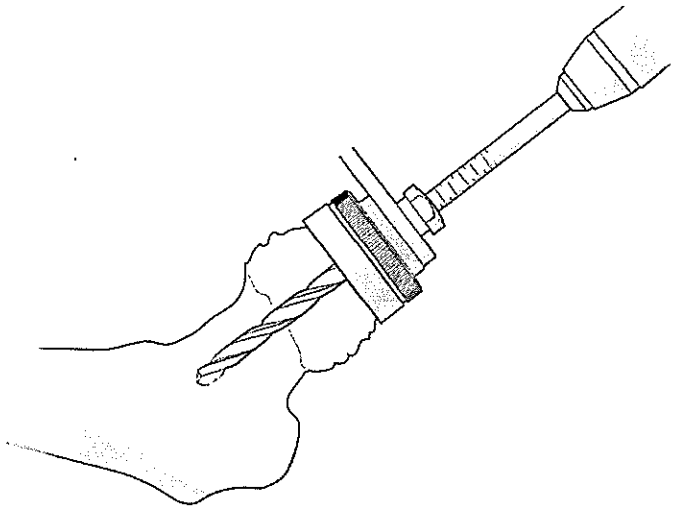




1. Use your best 3-D eye or C-arm to get guide pin into best centered neck position in appropriate valgus. Look at the guide pin from both sides of the operating table to be sure.
2. Place the femoral neck guide for the size.
3. Remember that the goal is the center of the femoral neck not the center of the head.
4. Use cannulated femoral drill over "best centered pin" down to mark.

   Use femoral head shapers to complete femoral preparation.

6. Femoral Head Preparation



Femoral Component Size Selection

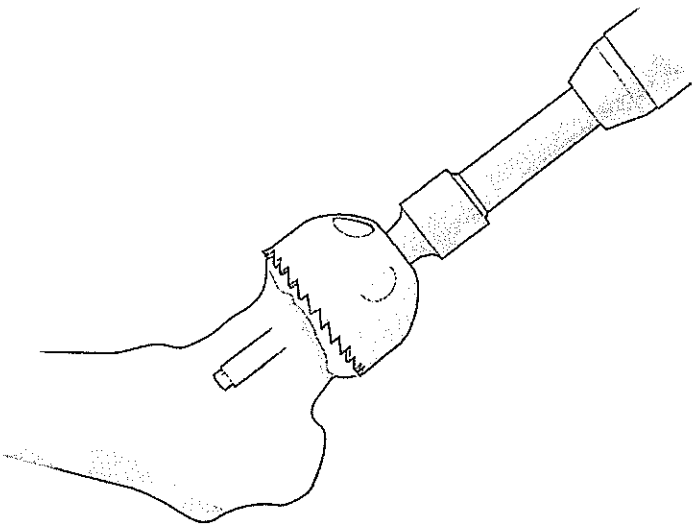
Use the Resurfacing Femoral Component that corresponds to the Acetabular Component size selected, e.g. A 56mm acetabular cup mates with a 44 mm femoral component. See the sizing chart on page 2 for all implant sizes.

Femoral Preparation

Assemble the FEMORAL HEAD DRILL GUIDE with the SIZE ADAPTER corresponding to the proper femoral component size to be used. Place the assembled Drill Guide onto the femoral head. Center the guide on the femoral neck and align the Guide Rod parallel to and centered on the calcar. Impact the Drill Guide Bushing with a mallet. Using the FEMORAL HEAD DRILL, drill a 1/4" hole through the guide down the center of the femoral neck and parallel to the plane of the calcar to the appropriate level marked on the drill shaft.

Note: Remove any overhanging osteophytes from the inferior neck of the femur to allow a clear view of the calcar from the level of the lesser trochanter.

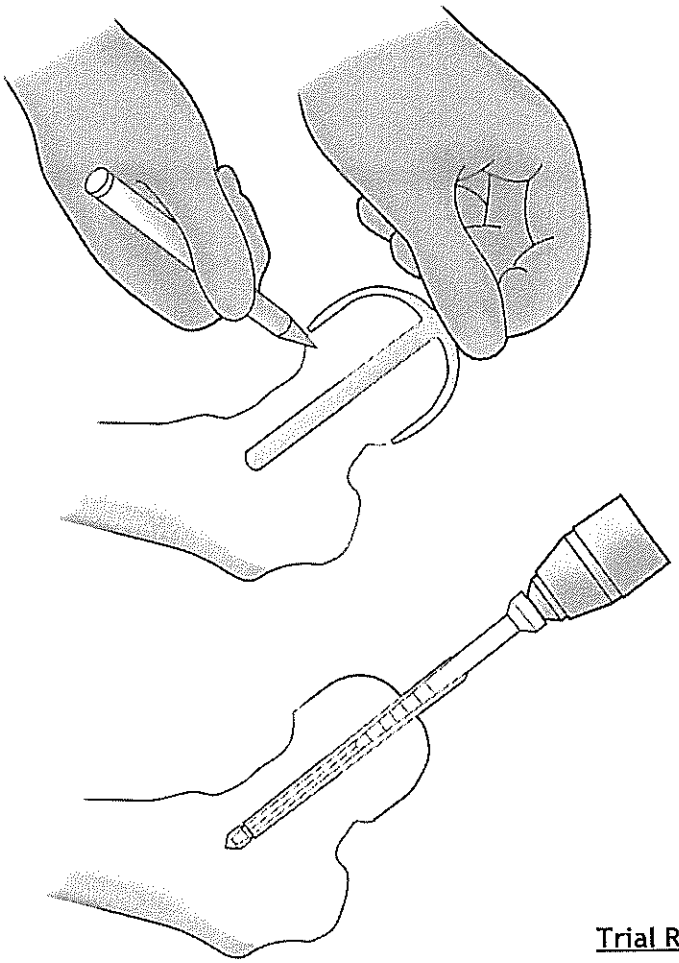
Caution: Do not use the femoral head for drill guide alignment, since pathology of the head may cause misalignment between the head and neck segments.



Engage the pilot shaft of the largest sized FEMORAL HEAD SHAPER into the drill hole and plane down the femoral head surface to remove osteophytes and deformities. Check the eccentricity between the neck and the shaped head. Plug and re-drill, if needed, to maintain centrality. Repeat with sequentially smaller sizes until the head is shaped to the proper size. Retain the subchondral plate in the superior weight bearing region of the head.

Note: If cysts or fibrous tissue are found in this region, curette this area down to solid bone, then drill the base of the cysts or avascular bone stock using a 1/8" drill parallel to the central neck drill hole.

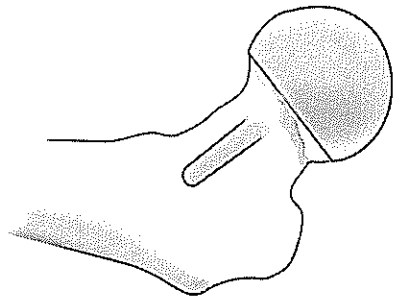
Caution: Evaluate the shaped femoral head atthis point. If it is insufficient to support a resurfacing component, useastem type prosthesis.



Place the properly sized **femoral component template** into the central neck drill hole and mark the level of final component seating with methylene blue or cautery.

Pass the **femoral head tapered reamer** down the central neck drill hole until it reaches the level corresponding to the femoral component size selected.

Trial Reduction of Components (optional)

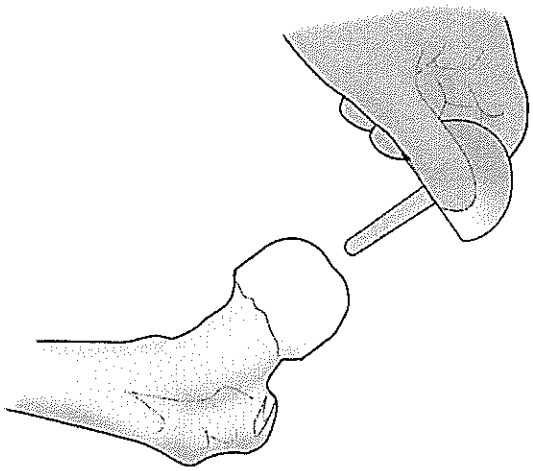


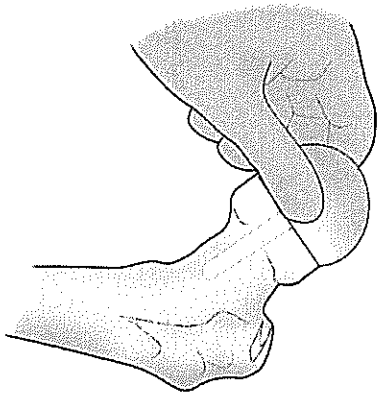
If an Acetabular Bearing has not been installed, insert a blue plastic **acetabular trial bearing** into the metallic Acetabular Fixation Cup as described in the top illustration on page 12.

Place the **femoral component trial** into the central neck drill hole. Reduce the **femoral component trial** into the Acetabular Trial and flex the hip to 90°. Internally and externally rotate the hip at 90° flexion and m ark the best acetabular version angle position to minimize dislocation. Adjust the Acetabular Component by edge impaction if needed.

After removing the trial components, insert the Acetabular Bearing as described on page 12, if it has not already been installed.

7. Femoral Head Implantation





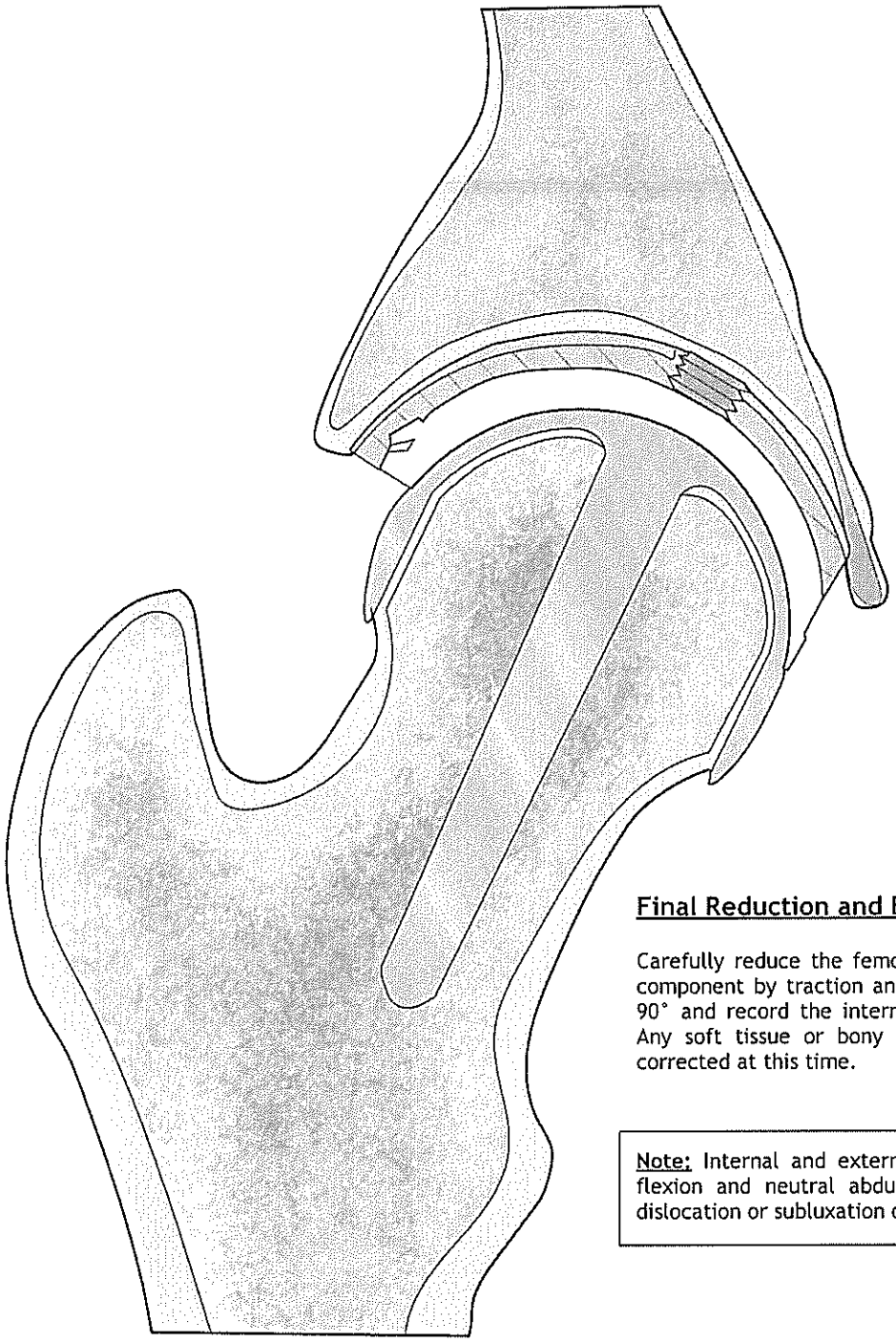
Femoral Component Placement

Engage the short tapered stem into the central neck drill hole. Apply morselized bone graft to any previously prepared areas of bone deficiency.

Drive the Femoral Component downward using a mallet on the concave **femoral component impactor** until the rim of the metal implant reaches the previously identified seating mark. Trim away any overhanging bone at the neck-prosthesis junction.

Note: An audible sound change usually occurs during impaction at the point of maximum seating of the femoral component.

8. Final Reduction and Evaluation



Final Reduction and Evaluation

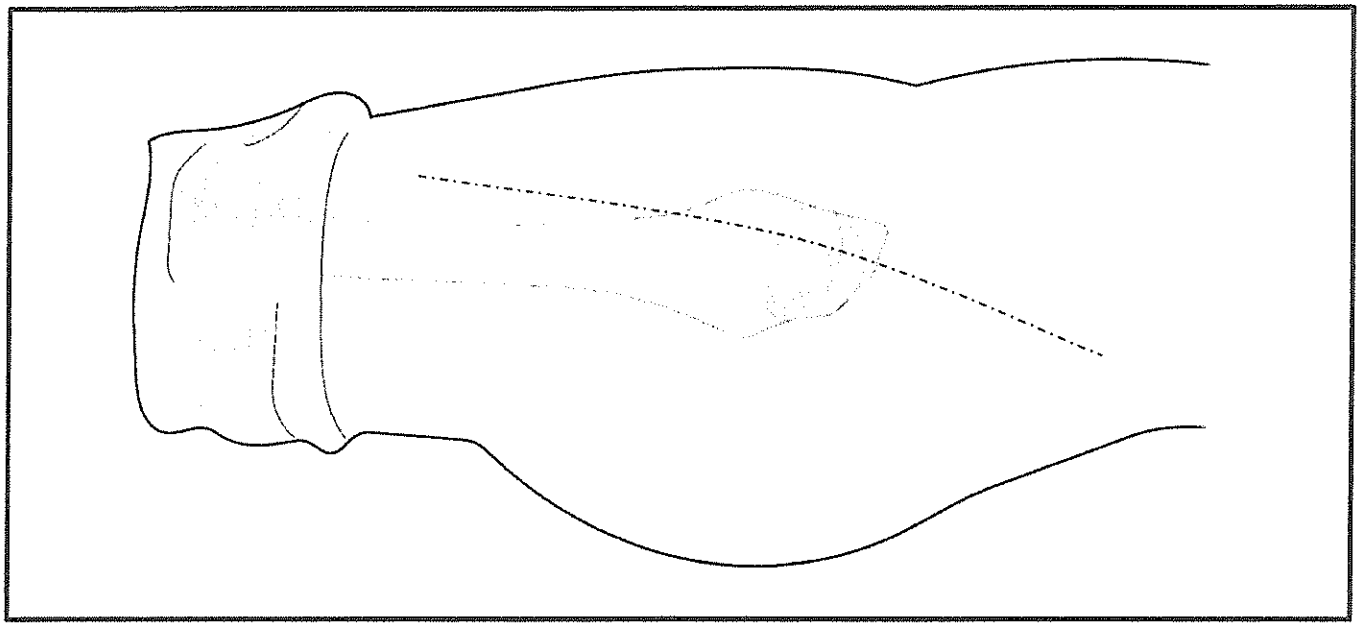
Carefully reduce the femoral component into the acetabular component by traction and internal rotation. Flex the hip to 90° and record the internal and external rotation available. Any soft tissue or bony impingement to motion should be corrected at this time.

Note: Internal and external rotation of 45° at 90° of hip flexion and neutral abduction should be possible without dislocation or subluxation of the components.

9.Closure and Postoperative Care

Wound Closure

Close the fascia with 1-0 absorbable suture. Reapproximate the short external rotators and pyriformis with #5 nonabsorbable suture through drill holes 1 cm apart, separated in the posterior aspect of the greater trochanter.
Close the subcutaneous tissue with 2-0 absorbable suture and then reapproximate the skin in a tension- free fashion with 3-0 nylon sutures, skin staples or a 3-0 absorbable subcuticular suture.

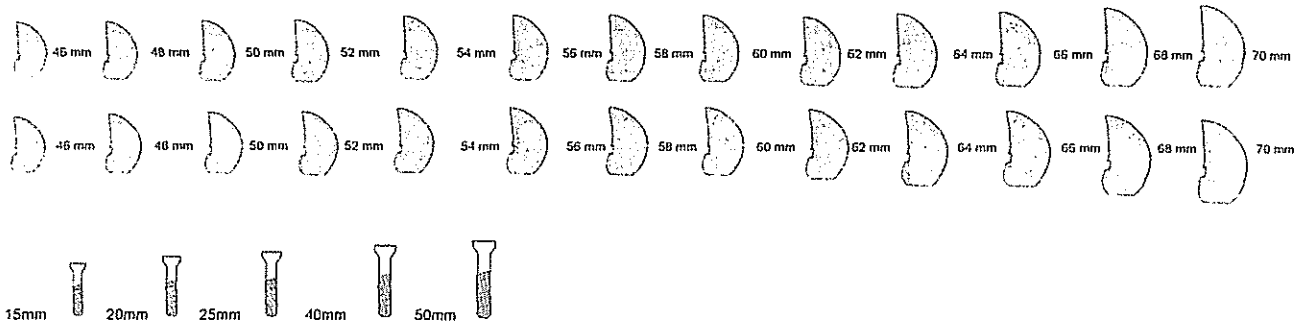


Postoperative Care

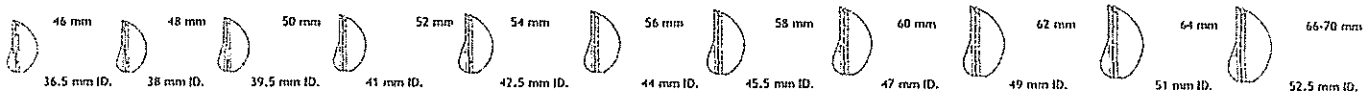
Apply an occlusive silver dressing to the wound and leave in place for 2 weeks. Place an abduction pillow between the legs for use in bed during the first 48 hours. Begin 150 quadriceps and gluteal isometric setting exercises on the first postoperative day, and allow the patient out of bed in a chair with the hip flexed less than 90°. Progressive ambulation with balancing weight bearing should also begin on the operative day. Hip resurfacing procedures are done on an outpatient basis. Progressive abduction, antigravity resistive exercises should begin after 6 weeks and continue until ambulation without a limp is achieved. Crutches, a walker or walking poles should be used for all ambulation activities during this interval (usually 6-12 weeks) to maintain a normal gait and avoid
an abductor lurch.

Resurfacing Hip System Implants

Femoral Resurfacing Acetabular Cups with Porous Coat & C-TiN-C



Femoral Resurfacing Bearing Components



Femoral Resurfacing Cups with Porous Coat & C-TiN-C